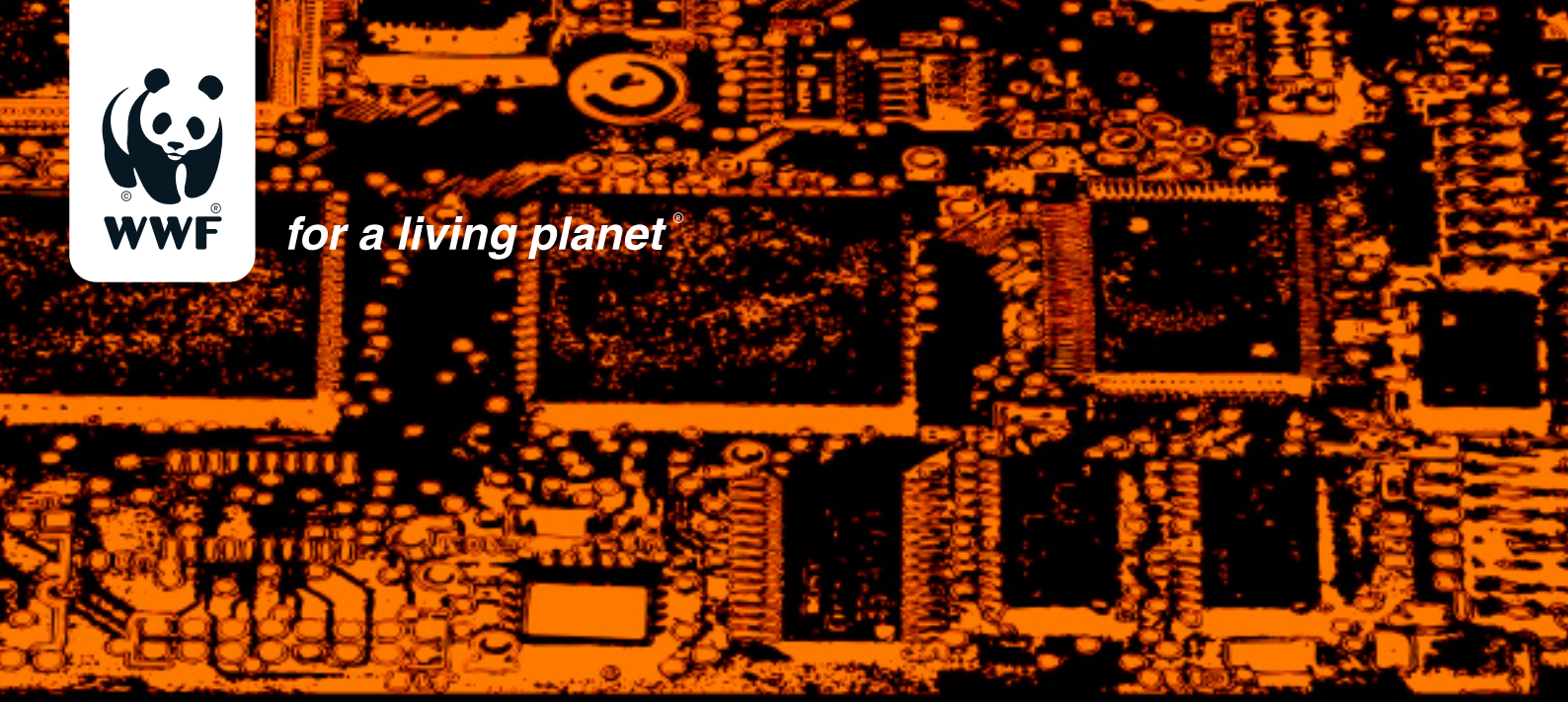


WWF

for a living planet®

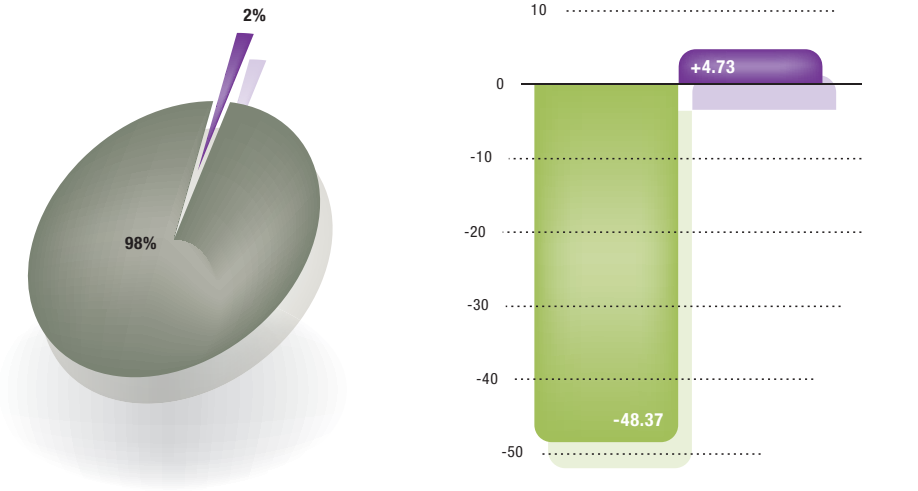
FROM FOSSIL TO FUTURE WITH INNOVATIVE ICT SOLUTIONS

INCREASED CO_2 EMISSIONS FROM ICT NEEDED TO SAVE THE CLIMATE

TECHNOLOGY@WORK 2008

TECHNOLOGY FOR BETTER BUSINESS OUTCOMES, BARCELONA, SPAIN 17-19 MARCH

RE-THINK ICT'S OWN EMISSIONS



Global CO_2 emissions *and* ICT's effect on CO_2 (reduction potential)

ICT own emissions Other emissions Example of ICT reduction potential, million tonnes CO_2[3]

In order to avoid dangerous climate change, ensure energy security and provide sustainable energy to a global population of more than six billion people and growing, we need more than incremental efficiency improvements in existing sectors. For too long, the climate and energy discussion has focused on such incremental improvements. Of course, it is not bad if cars, houses, aircraft, steel plants, cement production facilities, laptops, servers and other equipment all became more energy efficient, but it is not enough. This coming decade, we need to transform societies as aging populations, rapid population growth, record fast urbanisation and close to double-digit economic growth in countries like China and India, all result in a situation where business as usual is no longer an option. The danger, if we do not think beyond the current sectors and dominating stakeholders, is that the converging trends only will create tension and we will miss the opportunities for governments and companies to embark on a low carbon development pathway.

Looking from a traditional sector perspective, companies that want to contribute to lowering CO_2 emissions have traditionally strived to deliver products that are as energy efficient as possible. For the Information and Communication Technology (ICT or IT) sector, this has mainly meant that the production of the product and the product itself (when used) should consume as little energy as possible. In 2007, Gartner released a study which showed that the total CO_2 emissions from the ICT industry might contribute to up to 2% of global emissions.[1] This estimate is probably on the high side and the actual number may be closer to 1%.[2]

It is however important to take a step back and think about what's needed to deliver fast and significant CO_2 reductions in order to avoid dangerous climate change. Doing so would not only optimise user experience but also ensure that innovation can focus on delivering the services needed and not be restricted to existing solutions. Obviously emissions from the ICT sector should not be ignored, but the emphasis on reducing the emissions from the sector itself should be proportional to the potential for reductions through services provided. There is probably no other sector where the opportunity to provide solutions with dramatic emission reduction potential is as significant as in the ICT-sector.

The 98% window of opportunity

In 2005 WWF and ETNO (European Telecom Network Operators) demonstrated that six simple solutions that were already implemented on a small scale, could be scaled up to deliver more than ten times as much CO_2 reduction in Europe as the 16 operators emitted (see illustration based on third party verified reduction).[3]

This was the first successful attempt from WWF to shift focus from the emissions from ICT companies themselves to the solutions they provide. Still, the focus in most business, government, NGOs and media has not been proportional.

The "98% window of opportunity" for reductions by services provided by the ICT sector for other sectors versus the 2% the sector itself emits has not been reflected in terms of attention. Instead, the reverse proportions have been seen with 98% of the attention on the sector's own emissions.[4] One reason for this might be that the difference in ICT's own emissions and the savings they can deliver are in fact so striking that they become difficult to compare. Shifting focus from an ICT's own emissions also requires other methodologies. Another reason is probably that the current environmental discourse focuses on "problems", resulting in NGOs, politicians, media and companies running after the problems and creating structures, including legal, that only focus on the problems and not encouraging solutions.

4000% Increase in CO_2 emissions from ICT needed to save the planet?

One example that shows just how striking the numbers can be comes from a local government study in the UK where different reduction scenarios, reducing transportation and staff time, was analysed. In the best case scenario, the emissions from ICT would increase with more than 4000%.[5]

Annual Carbon emissions (kg of CO_2) associated with different scenarios for certificate requests at Sunderland

	Current [a]	Online Scenario 1 [b]	Change	% Change
Paper use	516	724	+207	+40%
Data Transfer	1	63	+61	+4,589%
Staff Time	26,462	21,647	-4,815	-18%
Travel	16,704	8,442	-8,262	-49%
TOTAL	43,684	30,876	-12,808	-29%

a Current = 1% electronic applications, 70% applications in person, 29% posted applications

b Scenario 1 = 50% electronic applications, 35% applications in person, 15% posted applications

The reason for this is obviously that the emissions from ICT are so small in relation to the savings it can support, even if the use of ICT is very dramatic. In the scenario, a 50% reduction in travel is so significant that the total CO_2 reduction would be just below 30%. Hence, a single-minded focus on absolute reduction targets of CO_2 from ICT would obviously not be very strategic, and could be counterproductive.

Obviously, we should aim for more energy efficient ICT equipment, but we must question where the investment and focus is delivering the most significant reductions and if a rapid increase of ICT can help us move towards a low carbon infrastructure where later we can ensure that the ICT equipment uses renewables and is super energy efficient.

There are many opportunities for ICT to increase efficiency and reduce CO_2 emissions by using existing equipment and implementing existing solutions. There are also some challenges that should be addressed as we move forward.

Three examples of scenarios that have come to play a central role in the public climate debate are the "wedges" developed by Socolow, the "Stern report" and the "cost abatement curve" by McKinsey. All three have played important roles, but it is time to move beyond them now.

Dispelling the technological impossibility myth with wedges

When the scale of the reduction needed, i.e. 60-80% in developed countries in a few decades became evident, many decision makers shied away and thought it impossible.[6] Often, the first reaction was that there are not enough sustainable solutions available. In response to these discussions about CO_2 reduction, Pacala and Socolow introduced the "wedges" in 2004, where the necessary emissions reduction was divided into smaller parts, each expanding from zero to one billion tonnes over 50 years, and combined, the reduction could be achieved.[7]

While this approach showed that technology already exists to reduce the CO_2 emissions and that we need to think about a mix of options, the strength is to some extent also its weakness. The wedges build on existing technologies and six out of seven are on the supply side, renewable, fuel switch, carbon capture, sequestration (CCS), etc. The relations between the different wedges are not analysed and the different actors needed for implementation are left out. Still, the wedges approach is a very helpful tool that is very good to identify uncontroversial reduction opportunities and can also be helpful to identify ICT solutions that can deliver the first billion tonnes of CO_2 reductions.

Dispelling the economic catastrophe myth with cost assessments

Even if IPCC and many researchers had similar numbers for years, it was when Nicholas Stern released his report in October 2006, the Stern Review on the Economics of Climate Change that the horror stories in mainstream media about enormous costs to address climate change to a large extent ended.[8] Later, the abatement curve from McKinsey, released in September 2007, also contributed to the understanding among policy makers and businesses that it did not have to be very expensive to reduce greenhouse gases.[9] Most extensive studies, including IPCC, Stern and McKinsey, actually show that significant potential exists for CO_2 emissions with energy efficiency measures. Both studies, but in particular the McKinsey study, suffer from similar weaknesses as those in the wedges report. The strength with the two approaches is that they are very simple and straight forward; in the case of McKinsey, so simple that a linear graph for costs is presented. These limits are obviously well known by Stern and McKinsey and the objective was never to produce a roadmap to a low carbon society, but rather to expose some misunderstandings by using cost assessments. These cost assessments have allowed McKinsey to graphically show that two of the main technologies proposed by the less progressive power utilities, nuclear power and CCS, will not play a particularly important role regardless of how much we focus on them due to simple cost reasons. This contribution is very valuable and might encourage more policy makers to think about system solutions and listen less to vested interests.

We must however recognise the limits of these economic studies. With focus on the supply side and incremental improvements from a global macroeconomic perspective, these studies are not very helpful if we are looking beyond the low-hanging fruits. For significant CO_2 reductions that avoid dangerous climate change, these approaches can, if used in the wrong way, actually become counterproductive due to their strong focus on the supply side, as this tends to encourage power companies to stick to their supply side business models. If policy makers use them, they run the risk of excluding future key players, such a construction companies, architects, ICT companies, public transport authorities, etc. from the discussions, as well as developing low carbon road maps that can deliver true sustainability.

The Wedges approach, Sterns report and McKinsey's "abatement curve" have all helped move the discussion from "impossible" to "possible" and can guide some of our initial steps. As we are now moving towards actions that are meant to contribute to significant reductions, caution needs to be taken if we want to develop strategies and incentive structures for a low carbon future built on intelligence, innovation and a dynamic market approach that can deliver solutions for everyone.

What you do not see could be very significant

The main challenge of the years ahead is to create a more intelligent society where we can provide the services needed in more resource-efficient ways. The main contribution of ICT to reduced CO_2 emissions today is in the area of energy efficiency, or energy productivity. With more intelligence, it is possible to get the same or better service with less use of energy. So why is ICT not used more, and why do more experts not focus on it? This is partly due to the fact that most energy experts usually work on the supply side, work for or are paid by companies on the supply-side, and that it is easier to create models based on a centralised supply-side driven system.[10]

These reasons are all linked to the nature of ICT solutions. Most of the time, we cannot see them, and when we can, we often do not think of it as ICT. If we are to succeed and expand the current scope of ICT's role to combat climate change, the diverse solutions that comprise ICT need to overcome three key challenges to visibility:

1. What is visible might not have the highest potential to reduce CO_2, but is more easily adopted as it "can be seen".

The closest to a visible symbol for energy efficiency today is probably the energy efficient light bulb. In most cases, this is a good substitute for traditional light bulbs, but it does not lead to the kind of dramatic reductions needed. ICT could contribute more. However, to provide more efficient lighting for example, it becomes necessary to think of solutions that stem from building design that uses natural light, introduction of fibre optic lighting, automatic control of windows and reflecting mirrors. These can result in much more significant savings, but are not as visible.

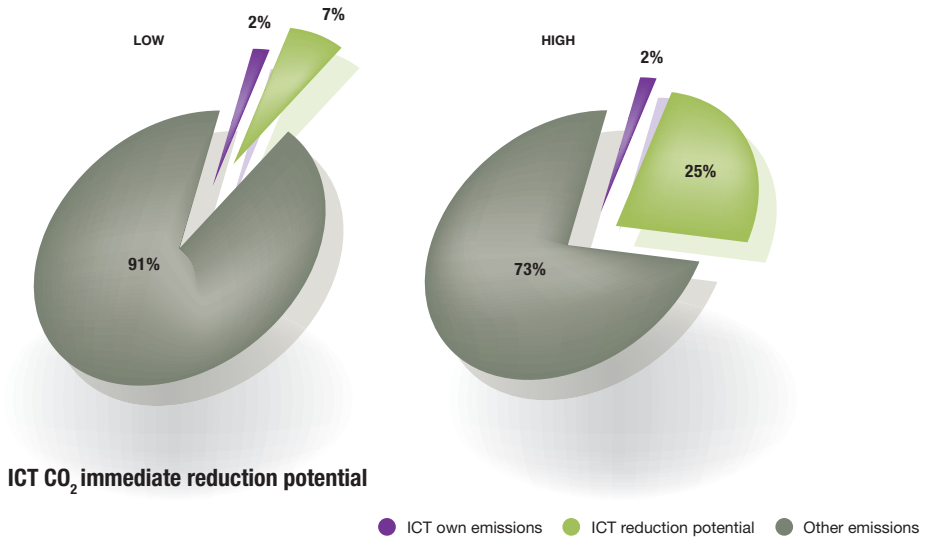
2. Most ICT solutions are not visible or tangible.

In most cases, "smart" solutions cannot be seen as easily as traditional solutions. For example, dematerialising (moving from products to services) is not as visible as producing more goods. Another example is an "intelligent building" which does not necessarily look very different from its counterpart that lacks a building automation system and integrated smart solutions. However, in many cases, sustainable measures on the supply-side are very visible – so visible that wind-power mills and solar panels have become symbols for a sustainable energy future. Obviously, these are good, but they are only one part of a larger equation.

3. When smart ICT solutions are designed as smart from the beginning, and not invisible as the examples above, they are often so different compared to their "dumb" counterparts that people do not see them as the same product.

Solutions that are not invisible are often so different, and might include features that are difficult to classify. For example when ICT is already used in the design phase of a building and integrated into its energy supply and lifecycle, making the house a net producer of electricity, the house can look totally different and include many different features to distinguish it completely from an ordinary building.

GREATER EFFICIENCY
Improving current systems with existing ICT



ICT CO_2 immediate reduction potential

Already in the short-term, existing IT solutions can play a significant role in improving current systems and make them less carbon-intensive. The fact that many companies see climate measures as risk management and sometimes just as a PR strategy, often obscures the fact that many companies have already achieved significant reductions using ICT solutions. Another reason is that ICT is adopted to increase efficiency, productivity and reduce costs, not to reduce CO_2.

Optimisation and dematerialisation
The way ICT can help in the short-term can be divided into optimisation, making the system more efficient, and dematerialisation, where services that used to be physical commodities can be tuned into digital versions.

Transport and communication
For transportation, ICT solutions can be used to improve logistics, where it can be used to both increase filling rates and ensure optimum travel routes.[11] An increasing number of companies are also using ICT to ensure that employees can work from where they choose instead of in an office from 9-5, Monday to Friday.[12] By investing in the next generation of virtual meeting equipment, companies can also provide a more efficient working environment where people do not have to fly on unnecessary trips.[13]

Buildings
For buildings, smart controls are available, but still not used very often.[14] By using smart controls, heat and light can be used only when needed, e.g. when people are in the rooms/building.[15] The areas where ICT can play a significant role are firstly improvements in buildings through efficient and natural lighting, more efficient electrical appliances, improved cooking facilities, passive and active solar design for heating and cooling. Secondly, improvements can also be made by ensuring an integrated design of commercial buildings; intelligent meters provide feedback and control and integrated photovoltaics in buildings. About 30% of projected green house gas emissions by 2030 can be avoided with net economic benefit.[16]

ICT OPTIMISING AND DEMATERIALISING CURRENT SYSTEMS

	Optimisation	Dematerialisation
Transport and communication	Improved logistics (filling rates and transport routes)	Videoconferencing Flexible work Remote controlling e-commerce
Buildings	Lighting, heating	Optimal use
Industry	Monitoring and analytical technologies Technologies managing user behavior	Marginal business areas (digital music and video)
Information	Use only when needed	No use of physical product at all
ICT products	More processing power with less energy and use of renewable energy	Virtualisation

New ICT systems can also ensure better use of existing building stock by ensuring that empty buildings and rooms are used before new ones are built and thereby reduce the need for new constructions.

Industry
In all industry sectors, ICT can contribute to increased efficiency though everything from the design phase and control of engines, to the choice of supplier and marketing strategy.[17] Three of the sectors with the greatest potential for efficiency solutions through these measures with ICT are the iron and steel, cement, and pulp and paper Industries, where small improvements can result in large gains due to the large amounts of emissions.[18]

Dematerialisation is still less used other than in a few sectors, but where ICT has been used, the impact has been profound.[19] Photos, music, videos and paper are being turned from physical products into "ones" and "zeros" with new actors emerging and old ones disappearing.[20]

Information
Information to customers and employees about making less carbon-intensive choices is an area with great short-term potential. More informed choices can steer behaviour for people to only consume or use a product or a service when necessary or not at all. For individual customers, food is probably the area with the greatest potential when it comes to delivering significant CO_2 reductions by individuals.[21] The reason is that buildings, transportation and heavy industries require significant investment in infrastructure in order to reduce the emissions to a sustainable level. For food, the choices made by individual customers has a much more direct effect.

The most important change, in most cases, is to reduce meat consumption (especially red meat). The need for reduction of meat consumption has been highlighted in various forums from The Food and Agriculture Organisation of the United Nations (FAO) and Scientific American.[22] Many initiatives are underway to see how labels and information can help customers choose a low carbon diet.[23]

ICT products
Even if ICT's own products only have a marginal direct climate impact, there is a great risk that the public will judge the whole sector as environmentally unfriendly if the sector does not address its own carbon footprint. Firstly, this would impact on credibility, making it difficult for the sector to explain why others should see the reduction of CO_2 as a driver of innovation and profit if they do not even use their own products. It would also make it harder for the sector to claim a leadership role as a winner in a low carbon economy, as any sale attempt could be seen as green washing. Secondly, if no action is taken, the rapid increase and penetration of ICT products can result in a significantly increased overall energy demand, even if it is not a key emitter.

Many initiatives and processes are in place to ensure that the ICT sector can address its own carbon footprint.[24] The principle of dematerialisation is also be-

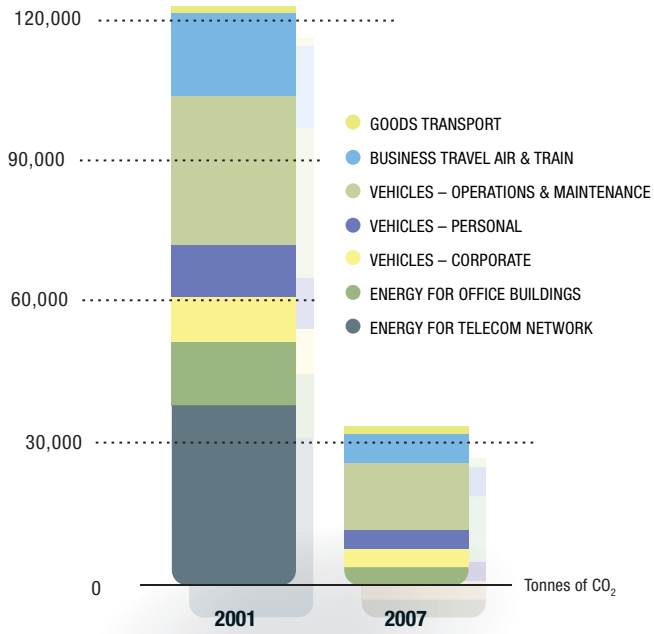
Eight steps towards a low carbon society

1 MOVE BEYOND BOXES
Current sectors/boxes are no longer very relevant. With a service perspective and focus on the easiest way to deliver CO_2 reductions, a focus on old sector divisions can often create more problems than it solves. **SOLUTION:** move from a product and sector perspective to a service and solution perspective. This shift in perspective is represented in the transformative change matrix by the boxes that have expanded over categories. A simple illustration will hopefully highlight that different areas cannot be dealt with in isolation.

2 PREPARE FOR NEW SITUATIONS AND HAVE SIMPLE SOLUTIONS READY
The new solutions are not only a matter of an increased use of ICT. As the penetration reaches certain thresholds, new capacities emerge and the system can move from one state to another. As opportunities emerge, solutions must be easy to understand and use in order to ensure fast uptake. **SOLUTION:** Ensure adaptive structures and modular systems with solutions that are easy to use and simple to understand. It is possible to create dynamic systems that can be constantly redesigned. Urban planning will have room for technology improvements to a much larger degree than today when wireless solutions and modular systems make improvements easier as better solutions become available.

3 CLUSTERS OF INNOVATION
Trends will converge in different

COMBINING MEASURES • E.g. TeliaSonera reached a CO_2 reduction of 70% in six years



The full potential is usually not seen until different measures are combined. There are often two kinds of synergy. First of all, the fact that the ICT infrastructure and equipment can be used for multiple CO_2 reducing measures and secondly, due to a more innovative and ICT friendly culture. The case of TeliaSonera is a very good example of how an integrated approach can deliver significant reductions today.[26] Between 2001 and 2007, TeliaSonera reduced the CO_2 emissions from their Swedish business by over 70%.[27]

NOTES AND TECHNOLOGY

Goods transport
IMPORTANT: Figure from 2001 is too low an estimate. It should have probably been stated at around 2,000 tonnes. But otherwise the goods transport has remained at a relatively consistent level. TeliaSonera do not own many transport vehicles; rather they rely on co-ordinated transport services such as Schenker to the greatest degree possible. Exceptions include pole transport vehicles, for example.

Business travel – air and train
Increased IT use / teleconferencing reduces demand for physical travel. "Meeting policy!" Netmeeting (Microsoft freeware), Telia teleconferencing + Telia web conferencing (services). Furthermore, over the last few years, an increased degree of use of latest-generation video conferencing of the Telepresens type etc.

Vehicles – operations and maintenance
Contractors: Requirement for hired contractors to drive less (financial incentive) through better management and coordination (IT support), more energy-efficient cars and increased use of alternative fuels to a greater degree. Various logistics programs. The most recently introduced logistics management program for TeliaSonera contractors is a product that they developed and sell themselves.

Vehicles – personal
Increased IT use and expanded remote handling reduces demand for short-distance travel. "Meeting policy!" Netmeeting (Microsoft freeware), Telia teleconferencing + Telia web conferencing (services). Increased remote handling through various "person-machine" interfaces via the telecom network.

Vehicles – corporate
Contractor work = Digging with heavy vehicles. Not so much construction activity since 2001. There is a lot of available network capacity.

Energy for office buildings
Reduced office space / staff. Better conference rooms with IT support (good speaker phones, overhead projectors, LAN connections for web conferencing, etc). One PC (laptop) and one phone (mobile) per employee! Mobile broadband with VPN to be able to work "wherever you are". Email and calendars with synching to mobiles, etc.

Energy for telecom network
Transfer to green power. Based on a Nordic power mix, this decision have a relatively large effect on GHG emissions.

ing used to reduce energy use in IT equipment, often under the name of virtualisation.[25] A driver for this improvement is that heat inefficiency has become a big problem for process power. Increasing energy efficiency is becoming a sales argument as it can reduce the life-time cost significantly when a lot of process power is required.

Short-term CO_2 reduction potential from ICT
It is obviously impossible to provide an exact estimate for how much CO_2 ICT can reduce and what proportion of "the 98%" can be reduced. Based on studies like the IPCC assessment reports, the Stern Report, IEA and McKinsey (that focus on low-hanging fruit and short-time possibilities), combined with earlier studies that have studied the possibilities for ICT to reduce CO_2 emissions with existing technologies, it is possible to make an assessment of the magnitude. With a focus on energy efficiency and some increase in renewable energy due to better pricing during peak demand, ICT can be used to deliver between two and seven billion tonnes of CO_2 reductions. This could be achieved with existing technologies just by scaling up solutions that have been proven to work and be profitable, without significant rebound effects. Compared with the current emissions from IT, that is approximately 1-2% of global emissions from ICT, translating to approximately half a billion tonnes.

This would mean that ICT could deliver between four and fourteen times its own emissions in the short-term, depending on how strategically we choose to use it.

> **"Already in the shortterm, existing IT solutions can play a significant role in improving current systems and make them less carbon-intensive"**

Avoiding re-bound effects
When developing strategies for short-term reductions with ICT it is important to conduct Life Cycle Assessments in order to ensure that the new service is really reducing CO_2. One of the most obvious examples is e-commerce an area with great potential, but where the savings due to more efficient storage and reduced transport purchasing can be shifted to the distribution line is not sustainable. This has sometimes been called the "Harry Potter Effect" after the very carbon intensive delivery of "Harry Potter and the Goblet of Fire". At the same time it is important not to bring all possible indirect effects into the equation. The fact that people who work from home might buy a bigger car or drive more is not part of the problem related to people working from home, but rather fuel prices and infrastructure, the same with inefficient heating and lighting in homes. Still a lot of people are looking for farfetched rebound effects when it comes to ICT solutions that would not apply to other sectors. No one would blame a car company for producing more energy efficient cars that result in people saving money on fuel and using them to buy a long haul flight, but these kind of arguments are common in the field of ICT and rebound effects.

ways, in different contexts and will create clusters of innovation. These clusters will be spread over geographical areas and include representatives from corporate, commercial and civil society.
SOLUTION: Look beyond current sectors/geographical areas and clusters and support transformative initiatives that allow us to think beyond nations, sectors and current thinking.

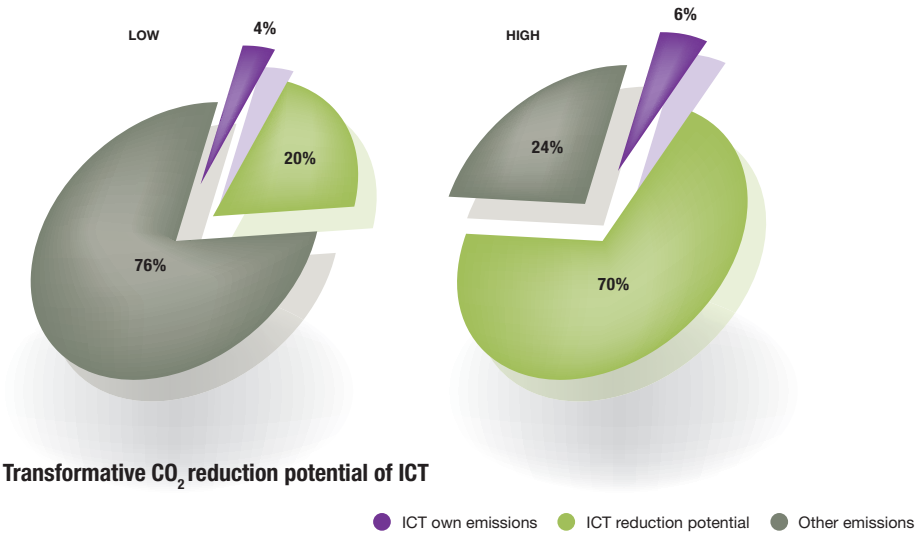
4 FROM TIME PERSPECTIVE TO SEQUENCING

Many of the most important changes were considered as impossible or highly unlikely up until they actually happened. As converging trends (increased bandwidth, computational power, connectivity, miniaturisation, etc.) all converge, we will see rapid change, but how and when is difficult to say.
SOLUTION: Avoid using time assessments in long-term strategies and try to use sequencing instead.

5 GRASPING CONVERGING OPPORTUNITIES

ICT is developing fast at the same time as biotech (referred to here as bio-mimicry, rather than genetic modification/manipulation). Nanotech and robotics also are all delivering new results. The combination of these will dramatically change the kind of solutions we can deliver.
SOLUTION: Focus on the opportunities for solutions that use technologies from different fields and encourage initiatives that integrate solutions from different fields.

DELIVERING TRANSFORMATIVE CHANGE
A systemic approach in new systems with innovative ICT



Transformative CO_2 reduction potential of ICT

Current reduction scenarios and government policies are almost exclusively based on linear models that focus on general reductions in all sectors, rather than supporting low carbon services in society.

In order to go beyond the current situation with incremental improvements that will not deliver sufficient results, we need to identify current challenges and see how we can ensure we can move beyond existing structures. When focusing on ICT's role for transformative change, it is therefore necessary to look beyond the existing system and linear thinking and also to focus on how ICT can help to transform the very infrastructure, incentive structure and even values in today's society.[31]

Analysing the potential from a transformative perspective is much more difficult as it requires us to look beyond existing structures. The current focus on simple numbers, simple graphs and linear developments in media and among most policy makers makes the transformative approach hard to explain in a few words or represent graphically in a simple way. The matrix below is an attempt to balance the need for a system that is easy to understand while at the same time capturing the most significant features of major CO_2 reductions with the help of innovative ICT solutions.

The areas identified are chosen as they can be used as a bridge from our current situation towards a knowledge-based low carbon economy.

Transport and communication
The transport system can be transformed into a hyper-efficient communication system where seamless solutions allow for physical or virtual transportation depending on need.[32] Full wall projections and even holograms can potentially allow dematerialisation where virtual and real spaces merge and allow team meetings and social interaction over any distance in ways that current virtualisation is only at the very beginning of.

When we start to re-think current transportation system solutions, ICT can also enable systems where fuel can be produced locally and where vehicles also become potential producers of energy when not in use for transport.[33] Such a shift could also allow buildings to be nodes in networks of different communication opportunities. To support the re-thinking of current transport and communication systems, initiatives that aim to ensure that the next generation of companies can build their business models around a sustainable approach to transportation is important. [34]

Buildings
Re-thinking buildings is already something that many leading companies are doing and initiatives are looking into.[35] While significant energy efficiency is possible and smart planning can result in more efficient use of buildings, the big change will come when buildings become part of the solution and not users of energy as today.

Net producing houses are already available, and with integrated solutions, such as intelligent grids, they can become mainstream in a few decades. Architects have shown that buildings can be designed to operate with far less energy and even become net producers of electricity at little or no additional cost. This would be accomplished through proper siting, building form, glass properties and location, material selection and by incorporating natural heating, cooling and ventilation and daylighting strategies.[36]

Industry
Industry might be the area where the most dramatic changes will be seen. While we see a general shift towards a more service-based global economy, the natural resource and energy-intensive sectors are still growing in an unsustainable way.

Heavy industry today is based on linear models where extraction of natural resources, renewable or non renewable, is the key feature. Iron and steel, cement, aluminium, paper and pulp are all part of the problem. Not only are they using a lot of energy, they are also part of a Western development model that cannot provide six and a half – and soon to be nine – billion people with even the most basic needs.

Re-thinking business models in heavy industry offers the possibility of migrating these companies to service companies, focusing on what people want, rather than trying to create an ever-increasing demand for finite resources.[37] Using ICT will allow businesses to develop their services from a cradle to cradle perspective where waste is turned into a historic concept.[38]

ICT DELIVERING TRANSFORMATIVE CHANGE

	Optimisation	Dematerialisation		Re-thinking
Transport and communication	Integrated systems	Remote controlling	From workplace to noplace	Vehicles as sources of energy
Buildings	Integrated systems	Multi-functionality		Buildings as net producers of electricity
Industry	Cradle to cradle	Virtual power plant Smart grid		Bio-mimicry Living urban systems Intelligent grids
Smart systems / Re-design / Urban planning	Tailor made	Service-based and adaptive		
Information / Consumption patterns / Ethics	Faster and more correct decisions	Value non-material services with global ethics		Redefining progress and institutions from competition to collaboration

Eight steps towards a low carbon society

6 RE-THINK SUPPLY SIDE AND PRODUCT PERSPECTIVE

Over the coming years, supply chains need to change dramatically. From a linear model where a product is produced from 100% virgin material and is often transported unnecessarily, to nearly 100% recycled materials and a climate-smart production. ICT can also make it easier for companies to provide services instead of products. There will be no need to buy a washing machine. Instead it would be possible to pay for clean clothes. It will not be necessary to buy a fridge but instead rent a service for fresh food and so on.

SOLUTIONS: Use ICT solutions to shift form linear business model to circular models and shift from a product perspective to a service perspective.

7 AVOID HIGH-CARBON LOCK-IN

In almost all areas, IT can be used to improve efficiency, regardless of whether it is in the production of chemicals, cement and steel or exploration of oil and coal. When IT is used to increase efficiency in non-sustainable industries, the dangers of a short-term perspective becomes evident. By only improving the efficiency in existing industries, IT can actually accelerate unsustainable trends in society if the underlying trend is increasing the use of unsustainable products.

SOLUTIONS: ICT companies should try to ensure that traditional industries are not setting the agenda for ICT use to be invested in high-carbon infrastructure. Governments should

“[...] and also to focus on how ICT can help to transform the very infrastructure, incentive structure and even values in today’s society.”

With more sophisticated software, it will also already make it possible in the design phase to try the global sustainability impact, not only the direct effects from the product, but also the indirect and direct effects from the services provided.[39]

Smart systems / Re-design / Urban planning
Compared with the matrix showing better efficiency, there are two new areas as we shift towards a transformational approach. The first is Smart systems / Re-design / Urban planning. These solutions represent the interaction between the different parts in society and the opportunity to make things flexible so they can constantly be re-designed.[40] Urban planning will enter a new era where little central planning is required and still the system can interact and develop in a constantly more resource-efficient direction.[41] A more intelligent system will ensure a service focus and that prices reflect the long-term impacts as well as short-term price fluctuations which today are ignored. The current energy system is actually holding back renewable energy solutions due to its inability to provide the right price signals.[42] With intelligent grids connecting buildings and cars that can produce energy as well as industries, correct prices as well as efficient solutions will be the two cornerstones.

WWF have ongoing work in both China and India that focuses on low carbon city development, where buildings are a significant part, and brought a vision paper to the World Economic Forum in Davos 2008, with a focus on the transformative opportunities that the rapid urbanisation in emerging economies provides.[43]

Information / Consumption patterns / Ethics
The ethical and social aspects are often ignored, but at the end of the day, it is ethics that will guide us and steer what a future society will look like.[44] With the opportunity to make hidden consequences visible, unsustainable business will have a difficult time, and those who are part of a sustainable development have a comparative advantage, not only communicated through a price tag. As people, companies and governments can track their own and each other’s impact, how they affect the world around us, as well as the legacy they leave behind, new solutions can come sooner than expected, due the fact that it will be easier to make more informed choices and that these choices will be more transparent.[45] Making the consequences of choices visible is key in the shift towards the transformational approach, especially when it is possible to show the positive impact of different choices.

Potential CO_2 reductions from transformative change with ICT
If it is difficult to assess the potential for improved efficiency using existing technology, it is obviously much harder to assess the potential for transformative change. An estimate can be made based on the increase in buildings, urban infrastructure, anticipated technology development and planned investment in the coming decades and price development in areas such as ICT, new materials, construction, renewable and logistics.[46] A low estimate for a transformative contribution, where only a few sectors and countries embark on a transformative path using ICT would result in a 20% reduction of CO_2 and a high estimate where cross-sectoral and cross-national collaboration exists would deliver a 70% reduction of total CO_2 emissions. With the trends we see today, the transformative contribution from ICT would translate into emissions reductions between twelve and over forty Gigatonnes of CO_2 by 2050 (based on the BAU scenarios in IPCC’s fourth assessment report). These savings should be compared to emissions from the ICT sector itself that could increase from half a Gigatonne of CO_2 to a maximum of 4 Gigatonnes, if only fossil power is used for ICT.

To achieve a forty Gigatonne reduction with intelligent solutions would require not only a combination of technology breakthroughs, a new legal frameworks, new investments and trade rules, it would also require value changes where care for nature and future generations are integrated parts of the economic framework. On top of this, achieving these CO_2 reductions would also require significant investments in ICT.

Even if we manage to accelerate the energy efficiency and link new server parks and other ICT equipment to renewable energy in a strategic way, the emissions from the ICT sector during a transitional phase would still increase until enough renewable power is available. If the CO_2 emissions from ICT equipment were to double or even triple under a transition period due to a dramatic increase of intelligent and resource saving solutions that not only reduce CO_2 emissions many times over, this would obviously be very strategic, and something we should consider.

Endnotes

1 http://www.gartner.com/it/page.jsp?id=503867
2 Calculations from Jens Malmodin at Ericsson and others who have tracked ICT’s contribution over time indicate numbers closer to one percent.
3 http://assets.panda.org/downloads/road_map_speed_of_light_wwf_etno.pdf
4 This is changing and a good example is the following quote from Francesco Serafini, vice-president of Hewlett Packard in the EMEA region who at The European Business Summit (EBS) the 21st February said: “ICT covers 2% of the global energy consumption. We can work to halve it to 1%, but the priority is to work to decrease the remaining 98%.”
http://www.euractiv.com/en/infosociety/eu-plans-mandatory-energy-efficiency-standards-ict/article-170472
5 “An e-Government Truth - Potential CO_2 efficiencies from online provision of local government services”
http://www.communities.gov.uk/documents/localgovernment/pdf/661782
6 The time between 1992 when the UNFCCC was put in place and 1997 when the Kyoto protocol and the endless discussions over details after Kyoto, as well as the lack of action by governments and companies, is telling. With each IPCC report, it became increasingly difficult to deny the challenge, but at the same time, the targets had actually moved in the opposite direction. Few seem to remember the climate conference in Toronto in 1988 where a target was set to reduce CO_2 emissions by 20% by 2005. Almost ten years later in Kyoto, the government agreed to reduce emissions by 5% over a similar time period. On top of this, the Kyoto protocol also introduced a lot of loopholes that eroded the actual target even further.
7 http://www.princeton.edu/wedges/
8 http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/sternreview_index.cfm
9 http://www.mckinsey.com/clientservice/ccsi/
10 One example of a supply side actor that used to be quite progressive is Shell. For a few years they produced interesting material, but these days, the focus seems to be on oil extraction from tar sand and CCS. Maybe this is not surprising for a company depending on revenues from a system where these sources would require little to no change.
http://www.shell.com/home/content/aboutshell-en/our_strategy/shell_global_scenarios/two_energy_futures/two_energy_futures_25012008.html
Vattenfall’s work is of a similar nature, also with a focus on the supply side and built around CCS as the main solution. http://www.vattenfall.com/www/vf_com/vf_com/365787ourxc/368149repor/index.jsp
11 http://www.greenlogistics.org
12 http://www.iiiee.lu.se/Publication.nsf/$webAll/7451EFF2A3CDEDE2C1256BE60040D980/$FILE/arnfalk.pdf
http://www.teleworkexchange.com/
13 Obviously it is not a matter of either/or. People will always fly, but many meetings, especially internal meetings, are often more efficient over video than flying.
14 http://www.nist.gov/public_affairs/guide/enhanced_building.htm
15 http://www.nwo.nl/nwohome.nsf/pages/NWOA_6WEJ93/$file/presentatie_project_Lulofs_2007.ppt?openelement
16 IPCC, Professor Ralph E H Sims, CLA Energy Supply Chapter 4, IEA Renewable Energy Unit www.ipcc.ch/pdf/presentations/briefing-bonn-2007-05/mitigation-potentials-energy.pdf
17 www.iea.org/Textbase/npsum/tracking2007SUM.pdf
www.iigcc.org/docs/PDF/Public/ConstructionSector_2004.pdf
18 http://eneken.ieej.or.jp/en/data/pdf/324.pdf
19 http://www.environment.fi/default.asp?contentid=85813&lan=en
20 www.itu.int/dms_pub/itu-s/md/03/wsispc2/c/S03-WSISPC2-C-0043!!PDF-E.pd
21 http://www.foodaware.org.uk/22_06.htm
22 http://www.fao.org/newsroom/en/news/2006/1000448/index.html
http://www.sciam.com/article.cfm?id=10-solutions-for-climate-change&page=2
23 http://www.ft.com/cms/s/0/966e2910-a765-11db-83e4-0000779e2340.html?nclick_check=1
24 Two examples of one such initiative is the Climate Savers Computing Initiative, a nonprofit group of eco conscious consumers, businesses and conservation organisations.
http://www.climatesaverscomputing.org/ and the Green Grid http://www.thegreengrid.org
25 With virtualisation, a single computer or server can run multiple operating systems and applications simultaneously, tasks previously relegated to separate machines. Virtualisation drastically reduces the number of servers, storage devices and related hardware in data centres, resulting in cost savings in real estate and electricity. To date, more than 1.2 million servers have been virtualised globally, which is equal to saving 8.4 billion kilowatt-hours of electricity a year, according to the Gartner Data Center Conference.
http://www.gartner.com/it/page.jsp?id=499090 from Technology CEO Council’s “A Smarter Shade of Green”
http://www.techceocouncil.org/index.php?option=com_content&task=view&id=266&Itemid=160
26 TeliaSonera is the leading telecommunications company in the Nordic and Baltic region and also holds strong positions internationally in mobile communications in Eurasia, including Turkey and Russia.
http://www.teliasonera.com/about_teliasonera
27 TeliaSonera third party verified the first set of reductions but has not (yet) verified the last, but they have provided transparent information about the measures and reductions.
28 Low-hanging fruits for energy efficiency and short-term renewable potential
http://www.ipcc.ch/ipccreports/ar4-wg3.htm
http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/sternreview_index.cfm
http://www.worldenergyoutlook.org/2007.asp
http://www.mckinsey.com/clientservice/ccsi/
ICT potential
Saving the Climate @ the Speed of Light’ (2006) ETNO and WWF
‘Advanced Electronics and IT: The Innovation-Led Climate Change Solution’ (2007) AeA
‘CO_2 Reduction with ICT: Prospects and Barriers’ (2007) L. Hilty in Hyrniewietz, Studzinski and Romanium (eds), Environmental EnviInfo, 2007.
29 For an example of an outline of a sustainable IT strategy for governments, see “IT and sustainable development – a central issue for the future” available at http://assets.panda.org/downloads/itsustainabledev.pdf
30 “Press releases from FedEx trumpeted the fact that their deliveries required a dedicated fleet of 100 aircraft and 9,000 trucks. The venture set a record for the online provision of goods in volume. It also probably set a record for the quantities of empty shipping boxes and packaging that would end up in landfills, let alone the energy used – and transport pollution caused – in the deal.” From http://www.oecdobserver.org/news/fullstory.php/aid/415/How_much_did_Harry_Potter_cost_.html
More about the Harry Potter Effect in “Sustainability at the speed of light” http://assets.panda.org/downloads/wwf_ic_1.pdf
31 http://www.leonardo-energy.org/drupal/book/export/html/2321
32 www.thepep.org/ClearingHouse/docfiles/sweden%202050.pdf
33 http://technology.newscientist.com/article/mg19125621.200
34 http://www.microsoft.com/smallbusiness/resources/finance/business-travel/virtual-meetings-cut-travel-costs.aspx
35 http://www.wbcsd.org/includes/getTarget.asp?type=d&id=MjMyMTI
http://climat2050.org/uploads/conferencier/documents/powerp-bennett.pdf
36 http://www.aia.org/SiteObjects/files/architectsandclimatechange.pdf
37 http://www.eco-industry.org/
38 http://www.mcdonough.com/cradle_to_cradle.htm
39 http://www.idsa.org/whatsnew/sections/ecosection/pdfs/IDSA_Business_Ecodesign_Tools.pdf
http://www.cfsd.org.uk/
40 http://www.citiesplus.ca/
http://www.plan.aau.dk/tms/bb/bbuk.php?id=4&st=1
http://www.earthinstitute.columbia.edu/csud/
http://www.cisco.com/web/about/ac79/ps/cud/carbon.html
41 stuff.mit.edu/.../Urban_Metabolism/TGOFF/readings%20and%20websites/3dmappingoptimizationGoogleEarth.pdf
42 As one recent study from Berkeley showed “the increased value from real-time valuation of solar power could be in the 30%-50% range. http://www.ucei.berkeley.edu/pwrpubs/csem176.html
43 From Coal Power Plants to Smart Buildings at the Speed of Light – How urbanisation in emerging economies could save the climate: http://www.pamlin.net/written/documents/WEF-2008-ICT.pdf
44 http://economistsview.typepad.com/economistsview/2007/11/nicholas-stern.html
http://www.cceia.org/resources/articles_papers_reports/climate_change_and_global_economy/taylor_july_16.html
45 http://www.independent.co.uk/environment/climate-change/enemy-of-the-planet-the-ethics-of-consumption-458752.html
46 The detailed calculations will be presented in a separate paper. Sources include: UNFCC, Estimates of investment and financial flows for mitigation in 2030, Dialogue on Long-Term Cooperative Action, Vienna – August 28, 2007; World Energy Council 2007 Deciding the Future: Energy Policy Scenarios to 2050; OECD, Infrastructure to 2030 TELECOM, LAND TRANSPORT, WATER AND ELECTRICITY, June 2006; IEA, World Energy Investment Outlook to 2030; 2003 World Energy Outlook 2020; 2002 IPCC Fourth Assessment Report Working Group III report “Mitigation of Climate Change”; FPRI, 2020 Global Food Outlook, Trends, Alternatives, and Choices; National Electric Delivery Technologies Roadmap, US Dept. of Energy, Office of Electric Transmission & Distribution, Jan 2004; Energy Information Administration, US Dept. of Energy, Annual Energy Review, 2006; Transport Operations Research Group, School of Civil Engineering and Geosciences Future intelligent infrastructure: Transport in 2050 Future intelligent infrastructure Booz Allen Hamilton, Strategy and Business, Light, Water, Motion, Spring 2007; National investment plans in countries like China, India, US, Japan and the EU

support companies with strategies and solutions for a low carbon economy, for both large and small companies.

8 RE-THINK PROGRESS
Marginal and even structural economic changes are insufficient to address the dominant culture that equates increased material consumption with improved welfare. There are many indications that a lot people would like to live in a culture where more room is left for reflection, participation and discussion. ICT’s role in enhancing these elements will be a great opportunity for change, despite many traditional influential actors seeing this as a threat to their short-term profit. On the other hand, many people would probably enjoy the challenge of solving many of today’s problems, and of being a part of a cultural change where “quantity” is left behind, and a new focus put on “quality”.

SOLUTIONS: The shift to a low-carbon society can not be perceived as a mere technological issue, since it is a change of perception that goes far beyond substituting as many of today’s products with services as possible.It is about fundamentally questioning what society needs, and how these needs can be met in an ecologically sustainable and ethically acceptable manner. ICT can provide both ways to measure progress in new ways and provide information that allow society to integrate non monetary concerns in new ways.

ICT for efficiency and transformative change

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This paper is based on WWF's work with IT/ICT, especially the joint initiative with HP where the key objective is to identify the first billion tonnes of CO_2 reductions through the use of IT. The text is written by Dennis Pamlin, Global Policy Advisor, WWF and Suzanne Pahlman, Strategy and Innovation Consultant (www.spahlman.com).

WWF is the world's largest and most experienced independent conservation organisation, with almost 5 million supporters and a global network active in more than 90 countries.

WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by:
- conserving the world's biological diversity
- ensuring that the use of renewable natural resources is sustainable
- promoting the reduction of pollution and wasteful consumption.

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For further information about WWF's work please contact:

Dennis Pamlin,
Global Policy Advisor,
dennis.pamlin@wwf.se

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